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Hybopses are not as widely different as supposed; and that the *Hybognathus osmerinus* is, in truth, not "specifically" distinct from the allied *argyritis;* that, in fact, it would be more consistent to consider these all, as we did the small blue *Stilbe* of our clay creeks.

If, by a "species," we meant anything other than a convenient arrangement of the various forms of animal life for purposes of study, or saw in the "species" of cyprinoids anything but so many varied forms which natural selection has evolved from some primitive form of omnivorous fresh-water fish, that has given rise to a variety of forms, through a long series of generations, that would, each in its own place and time, suit the particular haunts it chanced to frequent or was forced to occupy; if we have any other thought in view, then, it would be grossly inconsistent to add to the long list of so-called "species." We do not, however, consider "species" otherwise than as here sketched out, and considering also the amount of variation among any considerable number of individuals of any one "species," and believing that varieties are steadily though slowly becoming more and more varied, and so gradually entering what may be termed "specific territory," we claim that no undue use of the imagination will be brought into play, in recalling a primitive, typical cyprinoid, when we range, side by side, adult and young specimens of each of even the sixteen "species," that we have met with so far, in the Delaware River and its tributaries, in central New Jersey.

THE MIGRATION OF BIRDS.

BY T. MARTIN TRIPPE.

THERE is nothing connected with the fascinating study of ornithology that possesses a greater attraction than the migrations of birds. There is so much of the mysterious in their coming and going and we know so little of the manner in which their journeys are performed, that our very ignorance lends an additional charm to the mysterious interest involved. Anemones and buttercups spring up in a day, where yesterday they were not; but ere they come, we might have found the sprouting blades and tender buds that promised future blossoms as soon as the warm April rains should fall. Like the flowers, the birds come to us suddenly and almost unawares; a day ago there were none; to-day, the woods and fields are vocal with their music; but, unlike the flowers, there was no herald to announce their approach, no presage of their coming. Ere we are aware they are with us; before we know it, they are gone.

On some bright February morning, I go out into brown sere meadows, and wander along the banks of a brook, covered here and there with dense thickets of tall alders and hornbeams, with an undergrowth of blackberries and greenbriars. Yesterday, the only inhabitants they contained were tree-sparrows; to-day they hold a party of red-winged blackbirds, whose harsh merry notes and jolly chatter proclaim their joy at being home again. They have come, perhaps, from reedy marshes that line the Virginia coast; or, perchance, from Carolina rice-fields; but no man saw them on their journey; silently and unannounced, they came and reoccupied their summer haunts. A little later, I visit the same wet meadows, and find them frozen at the depth of a few inches, though on the surface, the black soil is soft and muddy; then comes a heavy rainstorm the next day, and on the succeeding morning, they are alive with snipe. Or, some morning in May, when the woods are beginning to unfold their green robes and the towhee to call from the thickets, I find, here and there, a warbler or two; but only one or two, save, now and then a troop of coronatas. A storm from the south sets in and lasts for a day or two; and when it has ceased, in the morning, I go out into the woods again; and hundreds and thousands of warblers of a dozen species are fluttering through the boughs and copses, and lisping in the tree-tops. How they came, I know not, nor whence; but here they are, where, a day ago, scarce one was to be seen. Two days more and nine-tenths of them are gone.

There are some birds whose migrations are apparent enough. In November we see flocks of robins passing south, high up in the air, calling to each other as they go. In March, and again, late in fall, long trains of crows silently stream across the sky; in September flocks of red-birds wing their way overhead, their presence betrayed by their mellow notes. The ducks, geese and cranes, with much noise and gabble, announce their passage through the country; and in the later days of autumn, the hawks, distant specks against the sky, are seen floating slowly southward after their departing prey. But the vast majority of birds come and go silently and unawares. No one sees the wren or the sparrow on its migration; no one knows how long they are on the way, or by what route they reach their destination. We know that they come from the south in the spring and return in the fall, and there our knowledge ends.

Most birds move north and south in their migrations; but although this is the general direction of the movement, it is affected more or less by various circumstances. On the seaboard, it follows the general course of the coast, and in the west it is influenced by the border line between the prairies and the forests which, throughout Minnesota and Wisconsin, lies in a northwest and southeast course. Mountain ranges and the interior lakes alter the general north and south direction more or less, and the isothermal lines point out other variations. Some birds appear to follow different routes on the autumnal migration from that which they take on the vernal. The Connecticut warbler, a not uncommon bird in northern New Jersey during fall, is exceedingly rare in spring; while, on the other hand, the Blackburnian warbler is far more abundant in spring than in fall. Other species, again, appear to take a fancy to some particular line of flight, and adhere to it for a number of years, then deserting it for some other. I have known the golden plover, for instance, to be quite abundant in certain localities, for two or three years; and then to disappear almost entirely for a long period. The greater number of vast flocks of wild fowl that sweep up the Mississippi valley every spring, on arriving at the mouth of the Minnesota, sometimes follow up one valley and sometimes the other; one of the two invariably attracting by far the larger proportion, though without any apparent reason.

The regularity which marks the arrival and departure of some birds is quite remarkable. For five successive years, I noticed the first coming of the crow and red-winged blackbirds on the 22nd of February, and so punctual were they, that at last I came to expect them almost as certainly on that day, as though they had been a company of players, announced to appear at a certain time and place. If the weather was unusually stormy or the reverse, their arrival was a day or two later or earlier. Between the 14th and 19th of October, I expected to see the southward flight of the crows; and very rarely did I fail to notice it within those dates. But other species show the very reverse of this regularity. The snipe and the ducks are notoriously uncertain in their movements, in some seasons coming weeks earlier than in others. The bluebird may be seen, in some years, every winter month; and in others, not one may be found till late in February. The bluebird, however, is a homesick little fellow away from his native orchards, and two or three fine warm days are apt to lure him back, even in the middle of January.

That many birds return, year after year, to the same localities is well established; but it may be doubted if this is the case with all, or even the majority. Spallanyane's experiment is well known; he tied bits of red silk to the legs of several swallows that haunted the house in which he dwelt; and spring after spring, observed the same birds return to their native place. A pair of bluebirds that had taken up their abode in a little bird-house, put up for their especial benefit, returned for several seasons to the same favorite nesting-place—at least I always fancied that I could recognize the same pair—and, as if to obtain undisputed possession of their snug quarters, invariably appeared a few days in advance of the other bluebirds. A pair of night herons took up their residence for three successive seasons, in a little, secluded swamp, where neither before or subsequently, for several years, were they ever seen. Similar instances doubtless occur to every ornithologist.

Of many species the males and females travel together; of some, the former precede the latter; but I know of none where the females migrate in advance of their mates. The robin is a familiar instance of the first case; and probably all the thrushes follow his example. The bluebird, in spring, almost always travels in pairs, except very early in the season when a solitary male sometimes appears. With the *Fringillidæ*, or most of the species, at least, the sexes migrate together. The redstart and some of the warblers appear a little before their less gayly-colored mates; and I suspect that this is the case with nearly all the *Sylvicolidæ*. The bobolink is a conspicuous example of the same nature; on the prairies of Iowa, flocks of hundreds of males may be seen, several days before a single female arrives. The rose-breasted grosbeak is still another instance, and many others might be mentioned. As a general rule when the males are brighter colored than the females, the former precede the latter; and when there is little or no difference between the plumage of the sexes, both travel together either in flocks or in pairs. In the autumnal migration this distinction is obliterated, and nearly all birds associate together in small parties or large flocks, composed of both sexes; and with many the females and young retire southward, a little in advance of the hardier, adult males.

Few birds are absolutely stationary. Even those that we see throughout the year are migrating to a greater or less extent. The robins that we meet with in midwinter have descended from higher latitudes, while those that passed the summer with us have gone to warmer regions. Specimens of the same species, taken in winter, differ from those of summer in being larger and stouter. The earliest birds that reach any given locality in spring are usually brighter colored and larger than those that breed there, the former passing farther north as the latter arrive. Most birds begin nesting immediately after arriving at their destination, and when, as is the case with the robin, the first comers appear weeks in advance of the breeding season, they remain but a short time, moving slowly northward until they have reached their homes when they at once commence the task of raising their young, shortly after which they begin retiring to the southward. There is thus a constant movement going on, interrupted only by the brief breeding seasons; a general swaying north and south in which one limit is scarcely reached, before a retrogression sets in towards the other; and when, as is frequently the case, the southern limit of the northernmost representatives of a species, is north of the summer range of the southern races, the species is looked upon as resident, although the individuals composing it are strictly migratory. This is the view of J. A. Alllen, as set forth in his interesting "Notes on the Birds of Iowa," and, I believe, corresponds with those of nearly all writers on the subject; but high authorities disagree. Audubon states that the snipe, *Gallinago Wilsonii*, does not appear in Canada and Maine, until nearly three weeks after it arrives on the marshes of New Jersey; while Frank Forester, whose observations in this case are quite as reliable, asserts positively that the snipe appears nearly simultaneously in northern New Jersey, and along the St. Lawrence River as far down as Quebec. The subject has been little studied, and promises most interesting results to a careful investigation; the lack of data however, is an almost insurmountable difficulty to be encountered at the very outset.

Yet some species remain in the same localities throughout the year. The gallinaceous birds are true residents of the regions in which they raise their young; and many of the *Corvidæ* shift their quarters very slightly, if at all, in any season. Some of the rapacious birds, especially among the owls, are quite stationary; and among the woodpeckers, are species that appear to reside constantly in the same localities. Other species, again, seem to be indifferently migratory or stationary. Of the vast numbers of mallards that frequent the ponds and streams of Texas, during winter, great numbers are said to remain and breed, while the others rove hundreds of miles to the northward.

In the "Natural History of the state of New York"* DeKay gives the Carolina titmouse as being found in southern New York in winter only. If this observation is correct, it affords a unique instance of a bird migrating north in winter; but there is good reason to doubt the accuracy of the statement.

The causes of migration are various; but the principal one is undoubtedly the want of food. Birds seek a milder climate than that of their native regions, because their means of subsistence fail, and they must either obtain it elsewhere, or starve. As soon as the chill of autumn destroys the greater number of insects, and banishes the remainder to their winter retreats, the insectivorous tribes are compelled to migrate to regions where a warmer sun sustains a sufficiency of insect life to supply them with food; and the granivorous species, finding their usual stores of seeds either becoming exhausted or covered with deep snow, follow in their track, while rapacious birds are obliged to accompany their prey. Only the species whose food-supply is unaffected by the inclemency of the season remain. The nuthatch and brown creeper are able to find as ample fare in one season, as in another, and a few sparrows find sufficient food in such scattered weeds as appear above the snow, or amid sheltered nooks and thickets protected from the storm. Even in the coldest weather, wherever the cedar berries are abundant, we find robins, who refuse to leave as long as they can find anything to eat; and bluebirds may be seen amid clumps of sumachs, clinging to their northern homes, until compelled to go by absolute necessity. In wet, springy meadows, and in grass fields, in the eastern states, the meadow lark finds a sufficient supply of food to subsist upon throughout the winter; while on the western prairies, under a less degree of cold he migrates as regularly as the kingbird, being unable to procure the requisite supply of food in his summer habitat. The snipe and the woodcock linger as long as they can find unfrozen marshes and swamps; and in mild seasons, may be found about warm, springy meadows and coppices, sheltered from the frost, even in mid-winter. But were it possible for them to find a sufficiency of worms, and could the warblers obtain such insects as they habitually feed upon, the woods and marshes, instead of being nearly deserted for several months, would remain tenanted throughout the year. Just as soon as the rigor of winter has passed away, and the changed temperature calls forth myriads of gnats and flies to swarm in the woods, and the frozen earth thaws, and permits the worms to approach the surface again, they come back to their native regions from which they had been temporarily driven by stern necessity.

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* Possibly, I am mistaken in the reference. If so, the statement is made in Giraud's "Birds of Long Island."

The supply of food, however, is so closely governed by the seasons, that the migrations may be said to depend upon them, although, absolutely speaking, the paramount necessity of subsistence, and not the mere effect of heat and cold upon the birds themselves, is the main cause. Hence, we find, as a rule, that the migrations of those birds, whose food is most affected by a change of temperature, are more regular and extended than those of other species, whose subsistence is more independent of the seasons. The Colopteridæ, Sylvicolidæ, and all insectivorous birds that capture their prey upon the wing, belong to the former class; their range extends, in most cases, many hundred miles north and south, and the migration is complete, few or no individuals lingering behind the rest in their summer abodes. The granivorous species on the other hand, living principally upon seeds, are more stationary, some of them finding a sufficient supply of food in their native haunts, throughout the winter, while the rest migrate southward, though they seldom go as far as the insectivorous birds. The omnivorous species are still more independent; some of them, as the raven, are strictly non-migratory.

Nevertheless, in some cases, mere temperature, unconnected with the question of subsistence, seems to be the motive in moving from one region to another. There is no apparent reason why the pine grosbeak should not find as abundant a supply of food in the northern forests during cold winters as in mild; yet it is only during the former that it descends to the latitude of New York; while in the latter it does not migrate as far south by one hundred and fifty or two hundred miles. The pine finch, and the crossbills are similar instances. On the other hand, a long, hot summer is apt to entice some southern birds farther north than usual.

Man exercises a very considerable influence upon the migration of some birds. The clearing away of forests, and the planting of trees upon the prairies, attract species that formerly could not find the means of support in those regions; and compel others to shun localities which they were wont to frequent. Fifty or sixty years ago, according to Audubon, the mallard and the wild goose, as well as some other species of water-fowl, bred in considerable numbers in the Mississippi valley; but as the settlement of the country progressed, they retreated farther and farther north, until at the present day, very few raise their young east of the Missouri and Red rivers, or south of the British boundary, although some still nest in central and western Minnesota, and northern Iowa. In this case the necessity of reaching a secure, safe retreat, remote from the settlements, has caused them to extend their migration far beyond its former limit. Doubtless a similar motive has acted in other instances with similar results. The desire to rear their young in quiet and seclusion, is a very strong one in many birds; and if disturbed or annoyed in any way, they will soon abandon the region, and seek another where they can pass the breeding season unmolested.

Violent storms, and sudden changes in the weather, are often preceded by, or accompanied with, extraordinary migration among birds. The immense flocks of pigeons and blackbirds that occasionally pass through the country are familiar to every one. Several years ago I witnessed an unusual migration of the latter bird, which I have never seen equalled, either before or since not even in the coast marshes where they sometimes congregate in enormous flocks. The latter part of February, and first week of March had been very mild and warm, and great numbers of crows, redwinged and cow blackbirds had gone north. There came a sudden, violent storm from the north one night, accompanied by showers of hail, snow and sleet, continuing all next day, and driving before it, immense multitudes of blackbirds. Vast flocks, flying close to the ground to escape the fury of the blast, passed by so continuously that it was often impossible to tell where one ended and the next began. For four or five hours the immense hosts kept sweeping by; the air at times seemed filled with them; and I was vividly reminded of Audubon's account of the wild pigeons in Kentucky. The storm expended its fury within a few hours after the last blackbird had passed; but although the next few days were clear and warm, not a bird reappeared for nearly a week. A similar migration of white-bellied swallows took place near Newark, New Jersey, some six or seven years since, in the latter part of October, just before a long, northeast rainstorm, followed by sharp frosts. Although their numbers were not equal to those of the blackbirds, the sky at times, seemed fairly covered with their hosts, tens of thousands being in sight at any moment for nearly an hour. Their course was to the southwest; and as if aware of the impending storm, their flight was hurried and direct, far different from their usual circling, easy motion.

But the most remarkable instance of the kind that ever came across my observation occurred in southern Iowa, in the fall of 1871. The weather, at the time, was the perfection of Indian summer,—clear, bright and warm. About the tenth of November, vast numbers of cranes began to fly south. Always a common bird in spring and fall, they appeared in such multitudes, that settlers, who had been in the country for twenty years or more, declared they had never seen anything to equal it. Thousands upon thousands covered the sky at all hours of the day, floating in slow easy circles, far up in the air all moving steadily southward. Most of them were of the sandhill species; but here and there, sweeping in wider circles far above their brown brethren as if conscious of their superior beauty, a flock of white ones appeared,—a beautiful sight, their snowy plumage and black quills sharply outlined against the blue sky; sometimes so high up that they looked like mere white specks, and their loud rattling cries sounded like faint echoes of the whoops of those far beneath them. For three days the remarkable procession lasted; then for the next two days, although the weather continued as warm and clear as it had previously been, not a crane was to be seen; and after that, without the slightest warning, a succession of violent snow, hail and rainstorms set in, followed by intense cold. On the 18th of November the mercury sunk to 5° F., and by the 22nd there was ice upon the ponds, five inches in thickness. The cranes had not escaped a day too soon.

Many birds prefer to migrate during peculiar conditions of weather. The crows almost always move north against a high March wind. A long rainstorm with heavy winds, in the early part of May, is almost sure to be followed, as soon as it has cleared away, by a great influx of warblers; and I have noticed that the migrating hawks often appear in much greater numbers than usual under the same circumstances. In May, 1865, a long northeast storm, clearing up in the evening of the second day, was followed by an extraordinary flight of hawks. Spending the day in the woods, I was astonished at the number, both of individuals and species. They passed overhead, just above the tree-tops, every moment; sometimes singly, sometimes in pairs, and at times in small parties of five or ten or even twenty or thirty. At a low estimation, I saw a thousand during the morning; and have no doubt that I might have seen ten times as many had I been in the open fields, instead of dense woods. The red-tailed, sharp-shinned, Cooper's and broad-winged species were the most common; but half a dozen other species were observed, including a golden eagle, the only one I ever saw in that locality. All were pursuing the same course—northeast—and all flew at nearly the same elevation, close to the tops of the trees, as if to avoid the strong head-wind as much as possible. Although I had nothing larger than No. 10 with me, such alluring shots were constantly presenting themselves, that I was tempted to fire a score of times or more, without loosening a feather. Had I been supplied with the proper ammunition, I might have secured fifty specimens that day. Other instances are afforded by the hummingbird, who journeys only on the brightest, sunniest days; and the snow bunting, whose predilection for travelling with snow storms, has gained for him, among the Swedes, the name of "bad-weather bird."

But although we may assign many reasons for the migration of birds, there is much about them that is seemingly inexplicable.

It is hard to say, for instance, why the black-throated bunting should delay his coming till May, when his relative, the chipping sparrow arrives a month earlier, and the song sparrow a month or six weeks earlier still; although neither is equipped with stouter bills or forms, or are apparently better adapted to withstand the cold. Or it would be puzzling to tell why Aiken's snowbird, which remains all winter in certain portions of Colorado finding abundant food, should migrate in spring, while a closely allied species, or variety, the chestnut-backed snowbird, appears just as the former is leaving, and occupies its place. That an insectivorous bird, as the wood pewee, for example, should delay its coming for a month or more after its cousin the phœbe, is explicable by the supposition that the two birds prefer different varieties of insects, and migrate only when they are to be found; but in the case of the granivorous birds, such an explanation is not admissible. It may, perhaps, be merely the force of habit; and such a theory is borne out by the fact that at distant points on the same isothermal lines, the different species do not, by any means, preserve the same order of coming. The water thrush and the towhee arrive two weeks earlier in central Iowa, than they do in northern New Jersey; the yellow-crowned warbler and two or three others on the other hand, are several days later; while most of the birds appear about the same time. But however that may be, whether future migrations will fully and completely reveal all the causes which influence the migrations of birds; or whether many of them are such as to baffle our researches, the subject loses none of its interest because we do not at present fully comprehend it, and must ever remain one of the most engaging studies in natural history.

ON THE STRUCTURE AND CASTING OF THE ANTLERS OF DEER.

BY JOHN DEAN CATON, LL. D.

My investigations of the structure, system of nutriment, mode of growth, cause of death and rejection of the antlers of the *Cervidæ* have led to results which may interest the readers of the NATURALIST.

Notwithstanding Buffon insisted that the deer's antlers were vegetable products, like shrubs, grown upon the animal body, comparative anatomy has long since recognized the fact that they are bone. They are composed of the same constituents as other bones, but with a larger proportion of animal tissue, and as we